



ESAVE

Environmental Stewardship &
Value Engineering

Quarterly Newsletter for the Nuclear Weapons Complex



LLNL's NIF develops P2/WMin procedure as follow-up to P2 Plan

The National Ignition Facility (NIF), a 192-beam, inertial confinement fusion laser, has been under construction since mid-1997 at Lawrence Livermore National Laboratory (LLNL). When completed, NIF will be a cornerstone of the U.S. Department of Energy's (DOE) Stockpile Stewardship and Management Program,

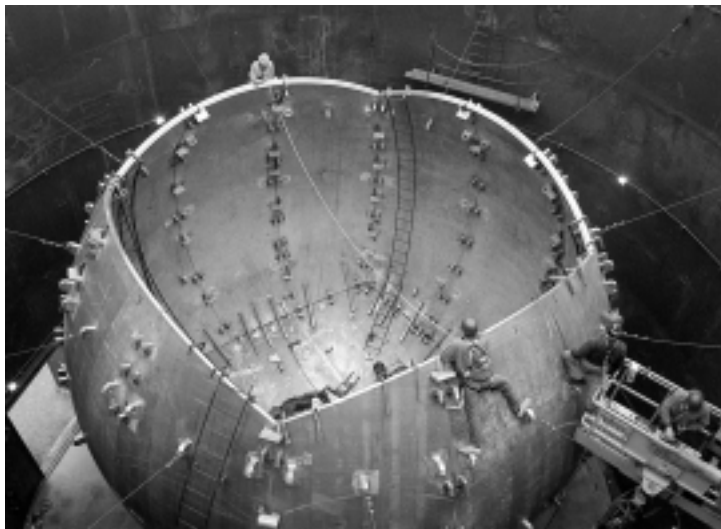


Photo by Jacqueline McBride

Workers construct the target chamber of the National Ignition Facility across the Loop Road from the fusion laser facility at Lawrence Livermore National Laboratory. Pollution prevention and waste minimization as functions of Integrated Safety Management are fundamentals of NIF operations and maintenance.

providing capabilities for research in fusion energy development, astrophysics and basic science. As construction progresses, operations personnel face a myriad of challenges to ensure that NIF is ready for start-up. The groundwork to successfully meet those challenges encompasses the preparation of operations and maintenance procedures under the umbrella of Integrated Safety Management (ISM), including a Pollution Prevention/Waste Minimization (P2/WMin) procedure. The P2/WMin procedure has recently been developed by the LLNL Pollution Prevention Group and the NIF Quality Assurance Office, and awaits formal approval.

See 'P2 Plan' on page 3

Kansas City Plant is saving environment by 'truckloads'

Recycling has long been part of the institutional culture at the U.S. Department of Energy's (DOE) Kansas City Plant. Now, however, instead of focusing primarily on office waste and scrap metal from manufacturing operations, restructuring and construction projects are providing new opportunities for the reuse of demolition materials.

Concrete and asphalt now account for a major portion of the plant's recycling activity. Other materials being recycled include aluminum, steel, copper, and even soil.

The Kansas City area and the environment have benefited from several recent projects.

Parking lot resurfacing completed last summer resulted in 3,000 tons of material that *didn't* go into a landfill. The asphalt and concrete were recycled to become roadbed material for new roads. That project alone accounted for 200 truckloads of environmental savings.

The installation of new underground monitoring wells yielded 1,335 tons of soil either reused on site or recycled. Nothing ended up in landfills—a "zero-waste" accomplishment.



Demolition materials like these, as well as asphalt, concrete, and soil, are the center of recycling efforts at the Kansas City Plant.

Following a fire-main project in one of the plant's parking lots, 462 tons of soil were returned to the ground from the site trench. For comparison, the excavation of a typical home foundation generates 924 tons of soil.

See 'truckloads' on page 5

EPIC listserv wants YOU for 'topic of the week' discussion

Users of the U.S. Department of Energy's (DOE) EPIC pollution prevention (P2) listserv are looking to share their knowledge and acquire information from others across the DOE complex.

"I'm surprised how little activity there is. I participate on a listserv (P2Tech) that is very active and very useful," said George Goode of Brookhaven National Laboratory. "DOE sites face many of the same problems and have similar opportunities. For example, I'm sure we all have tritium exit signs, vacuum pumps, HPLC systems, parts washing operations, sewage sludges, remedial actions, and so on. The EPIC listserv seems like a great communication tool to see how others are handling these waste streams and to share P2 opportunities.

"There are also plenty of administrative topics—P2 program organization, generating funds to support the programs, PPOA methodology, tracking cost savings, communicating successes, and so forth—that we all deal with," Goode added. For instance, Goode said he was seeking information through the listserv on P2 councils at DOE sites (see article on p. 5).

Goode suggested that EPIC administrators establish a "topic of the week" on the listserv to stimulate interest, an idea seconded by Keith Trychta of Argonne National Laboratory-East (ANL-E), a dedicated user since the listserv's inception in 1994.

"At a minimum, the EPIC P2 listserv has proven to be an excellent tool for advertising excess materials or locating needed materials from the DOE Complex-Wide Materials Exchange Program," Trychta said. "ANL-E has repeatedly benefited from this application of the listserv. Hopefully, in the future the listserv can improve the exchange of information between individual site P2 programs by increasing participation across the DOE complex."

EPIC, the official DOE Pollution Prevention Information Clearinghouse web page at www.doe.er.gov/epic, is a central-

ized source of DOE P2 information with links to valuable P2 resources outside of DOE. The EPIC listserv is a separate service for P2-related email exchange between DOE employees and contractors only.

Contact Arnie Edelman, EPIC, 301-903-5145 or arnold.edelman@science.doe.gov



Livermore WSAs show the right way to 'dumpster dive'

Personnel from the Pollution Prevention Group at Lawrence Livermore National Laboratory (LLNL) recently released a comparative evaluation of data from three nonhazardous solid waste stream assessments (WSAs) conducted from 1992 to 1997 at the California lab.

The most recent WSA followed a methodology identical to the first two: 25 dumpsters—10 percent of LLNL's total of 250—from the same locations were surveyed, a cross section of refuse from different facilities throughout the lab site. Selected dumpsters were transported to a sort area located north of the Wood Yard in LLNL's southeast quadrant, where a sorting crew separated each container's contents into nine categories. Totals of weight and volume for each category were recorded, and the divided contents were photographed.

Categories which showed the greatest reduction over the span of the three WSAs were colored/mixed paper and cardboard, while the greatest increase was in discarded plastics and

magazines. As a result of these and related findings, LLNL has identified areas of the lab site in which nonhazardous solid

waste reduction efforts have not been as effective as they could be. The lab will expand several existing waste-diversion programs such as the "mail-in" program for old newspapers and magazines, and implement new programs, for example, recycling co-mingled beverage containers.

The three WSAs constitute a snapshot in time, not a complete and detailed picture of refuse at the LLNL. However, multiple assessments conducted across several years have proven to be a useful technique by which to identify trends, address problematic waste streams, and increase employee awareness in targeted areas. LLNL continues to serve as a resource for facilities within and outside the U.S. Department of Energy complex on nonhazardous solid waste stream assessment methodology.

Contact Kent Wilson, LLNL, 510-423-2115 or wilson20@llnl.gov



Dan Guerro weighs in with cardboard from a dumpster being sorted for field tabulation by Kent Wilson in Livermore's third non-hazardous solid waste stream assessment.

'P2 Plan' from page 1

The P2/WMin procedure is one mechanism for implementing the goals spelled out for NIF in the National Ignition Facility Pollution Prevention and Waste Minimization Plan (see *Pollution Prevention Advisor*, 1st Qtr 1999). These goals include: 1) integration of P2/WMin strategies into the NIF design and operations; 2) accurate forecasting of waste streams; and 3) implementation of technically and economically feasible P2/WMin measures.

When it is triggered, the P2/WMin procedure addresses these objectives by:

- Encouraging incorporation of Design for Environment (DfE) principles into NIF operations and maintenance procedures.
- Gathering the data needed for waste stream analysis, prioritization, and subsequent P2 evaluation while processes are still being developed. This typically provides greater opportunity to make positive modifications.
- Providing a mechanism to promote P2/WMin awareness among those NIF personnel who regularly design and decide how work is done.

Additionally, the P2/WMin procedure incorporates ISM concepts. Robert Ehrlich, who will take on the role of Environmental Safety and Health (ES&H) Manager/Waste Minimization Coordinator (WMC) for NIF later this year, commented, "As the procedure developed, it was clearly desirable to bring it in line with how we are handling all of our other ES&H procedures under ISM. The procedure will be triggered when the NIF ES&H manager reviews Integration Work Sheets (IWS), one of which is filled out for each new or modified activity at NIF. To have the P2/WMin procedure parallel the review process for safety issues,



The National Ignition Facility in June, shortly after the 10-meter-diameter target chamber was lifted from its supports and lowered into place within the target bay.

the NIF WMC will obtain assistance from P2 experts in LLNL's Environmental Protection Department in gathering and evaluating the data," Ehrlich said. "Where applicable, completion of a basic P2 evaluation will be required before the activity is authorized to proceed. This IWS process is similar to the way consultations are requested from LLNL's Hazards Control Department disciplines on safety issues."

Contact Katharine Gabor, LLNL, 925-422-9790 or gabor2@llnl.gov

PNNL researchers recycle gasoline derived from fuel cell study

A project related to fuel cell development at Pacific Northwest National Laboratory (PNNL) has resulted in the discovery of a way to reuse gasoline that normally would have become a waste product associated with the research.

Would-be waste gasoline was generated during a project to determine whether a microchannel gasoline vaporizer developed by the U.S. Department of Energy (DOE) lab would support a 50-kW fuel cell.

In all, more than 800 kilograms of hazardous waste were eliminated by reusing the fuel. Finding a way to recondense the gasoline for other uses resulted in savings of more than \$25,000.

Initially, when the quantities of recovered vaporized gasoline were small, the fuel was turned over to Grounds Maintenance to run grounds-keeping equipment.

Jennifer Marco, Annalee

Tonkovich, and Gary Roberts redesigned the process as the amount of gasoline increased. Instead of the gasoline passing only once through the vaporization process, they created a recycle loop and reused the recondensed gasoline in the vaporizer.

PNNL did the work under the Partnership for a New Generation of Vehicles for DOE's Office of Transportation Technology. The microchannel gasoline vaporizer is just one tiny part of the multi-step fuel processor which converts petroleum fuel to hydrogen to run the automotive fuel cell.

The PNNL vaporizer, even though it consists of four parallel integrated microchannel reactors and heat exchangers, is about the size of a soda can, one-thirtieth smaller than a conventional vaporizer.

Contact Annalee Tonkovich, PNNL, 509-372-2741 or ay.tonkovich@pnl.gov



At Pacific Northwest National Laboratory Jennifer Marco, Gary Roberts, and Annalee Tonkovich (l to r) prepare a tiny microchannel gasoline vaporizer for testing as part of a process to convert petroleum to hydrogen for powering an automotive fuel cell.

BNL foam digests asbestos, retains fireproofing qualities

The U.S. Department of Energy's (DOE) Brookhaven National Laboratory (BNL) and W.R. Grace & Co. jointly received awards from *R&D Magazine* for their development of a chemical foam that safely digests asbestos in buildings and other structures while maintaining the material's fireproofing qualities.

The publication hands out its R&D 100 Awards every year in recognition of what it considers to be the top 100 achievements in turning basic science into useful products.

BNL and Grace developed the patented foam over four years of research and testing. Grace is now marketing the product, called digestive material for asbestos (DMA), for remediating asbestos fireproofing on building columns, beams and decking.

"We are pleased that our cooperative research with Grace resulted in a product that has proven to be highly effective," commented Ronald Webster, the Department of Applied Science (DAS) researcher who now heads the Brookhaven asbestos program. Webster lauded former BNL employee Leon Petrakis for inaugurating the research effort with Grace.

The foam, an acid solution, is sprayed onto the asbestos-containing material. It dissolves asbestos fibers into harmless minerals, turning it into a material that still retains its fireproofing functions but which is no longer considered a regulated material.

The active ingredients in DMA are phosphoric acid and a small amount of a proprietary fluoride catalyst.

The process is the first to destroy asbestos chemically without the material having to be removed. Conventional techniques for removing asbestos require the construction of air-tight barriers (as well as other safety precautions), labor-intensive scraping, and the installation of new material. Moreover, the new process produces essentially no waste and saves building owners the expense of disposing of regulated asbestos waste materials.

The foam was first evaluated in a BNL testing laboratory that was specially adapted to handle asbestos. It was then tested at a four-story building fireproofed with asbestos.

The DMA-treated fireproofing also was tested at Underwriters Laboratories using nationally recognized testing procedures.

Contact Ron Webster, BNL, 631-344-2845 or webster@bnl.gov



Gathered around test samples coated with non-asbestos-containing fireproofing are the BNL members of the BNL-W.R. Grace asbestos-abatement research team: (clockwise from front) Ron Webster, Toshi Sugama, Dave Elling, Walt Reams, Bob Sabatini, and Marita Berndt, all of the Department of Science.

Into the new millennium . . .

Now-costly chemical building block emerges from biomass research

Until the latter part of this century, biomass energy products had served almost exclusively as heating fuels. On the cusp of the new century and millennium, thanks to research at the U.S. Department of Energy's (DOE) National Renewable Energy Laboratory (NREL), Pacific Northwest National Laboratory (PNNL), and various industrial partners, exciting new uses for biomass loom.

The partnership developed a technology to convert wastes such as paper sludge, municipal solid waste, unrecyclable waste paper, waste wood and agricultural residues into levulinic acid (LA), a valuable industrial chemical used to make a range of everyday products and a substitute for petrochemicals.

The project combined funding and expertise from NREL, PNNL, and the New York State Energy Research and Development Authority, as well as from the private sector's Biofine, Chemical Industry Services, Merichem, and Pencor Environmental Ventures. In recognition of their research success, the research group recently received the U.S. Environmental Protection Agency's (EPA) Presidential Green Chemistry Challenge Award.

NREL senior chemist and project coordinator Joe Bozell said that, for the time being, LA is only a specialty chemical with few large-scale uses because it's so expensive to produce.

However, Biofine, a small company that operates an LA pilot plant in New York, developed an efficient way to convert waste to LA. The national labs focused on converting the acid to useful chemicals. Luc Moens of NREL's Chemistry for Bioenergy Systems Center converted LA to delta-amino levulinic acid (DALA), a

biodegradable herbicide/insecticide. The work at PNNL involved converting LA to methyltetrahydrofuran (MTHF), a gasoline additive projected for use as a transportation fuel extender.

Even the current, expensive variety of LA has found uses in small markets, as an important ingredient in chiral reagents, biologically active materials, polyhydroxyalkanoates, polymers, polymerization initiators, antifouling compounds, personal care products, lubricants, adsorbents, printing inks, coatings, electronics, photography, batteries, drug delivery systems, and corrosion inhibitors.

As to the variety of LA's applications, Bozell continued: "The new biomass conversion process can help reduce the tons of trash clogging the nation's landfills and replace petrochemicals made from imported oil. Commercially produced LA derivatives could become part of a new chemical industry based on renewable feedstocks."

LA-derived product could be blended at the refinery and transported by pipeline, a much more efficient process than the one involving ethanol fuel blending, Bozell elaborated. Also, "MTHF can be blended in gasoline up to 60 percent by volume without adverse engine (or mileage) performance. As a component of 'P-series' fuels (gasoline blends recently approved by DOE), MTHF can be used to meet the requirements for alternative fuel fleet vehicles stipulated by the Energy Policy Act of 1992."

Contact Joe Bozell, NREL, joseph_bozell@nrel.gov

Sandia National Labs' cafeteria gets Green Zia seal of approval

The U.S. Department of Energy's (DOE) Sandia National Laboratory (SNL) (New Mexico) Pollution Prevention (P2) and Energy Management offices performed a pollution prevention opportunity assessment (PPOA) and a Federal Energy Management Plan (FEMP) energy audit at the lab's cafeteria last summer. Fire protection and health and safety issues had put the SNL Cafeteria high on the renovations priority list, and Sandia's P2 group and the lab Energy Manager presented P2 and energy assessment recommendations to the design team for sustainable redesign of the facility.

From the PPOA, initiatives have begun to reduce solid waste and energy and water usage at the facility, replace



disposable Styrofoam™ and plastic serving ware in select areas, and install a new energy/water efficient dish-washing machine. These initiatives, carried out within New Mexico's Green Zia Excellence Program protocols, will result in a 40 percent reduction in solid waste generation and recycling of 10 percent

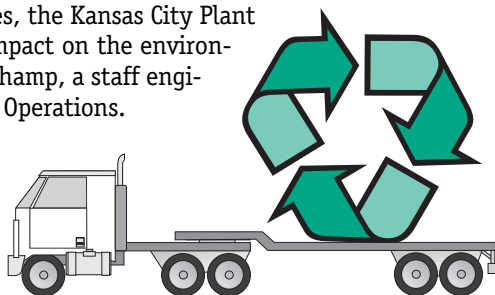
'truckloads' from page 1

The plant began recycling concrete in 1996, one of the first companies in the region to do so. This and other efforts have enabled the plant to reduce the amount of sanitary waste it disposes of by nearly 65 percent since 1993.

This proactive focus on recycling and reuse helped the plant's neighbors, too. Before it officially closed last year, Kansas City's Southeast Landfill needed a clean-soil cap. The Plant provided more than 600 tons of recycled soil for that project. Soil is also being sent to fill in a limestone quarry and create usable land. In another example, one KCP department plans to pull out 18.5 tons of steel for melting and reuse; in another, stainless steel frames for drop ceilings are being reused.

Recycling in construction and demolition projects is relatively new. New methods have been identified within industry and by being alert for better ways to do business. "Through the proactive efforts of our associates, the Kansas City Plant is making a positive impact on the environment," said Bob Beauchamp, a staff engineer in Environmental Operations.

Contact Rick Grabill,
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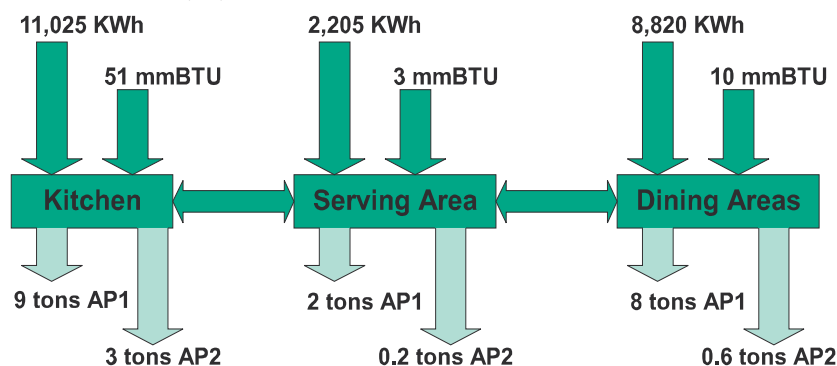


of the remaining waste streams in the lab's cafeteria facility.

Recommendations from the FEMP audit included substituting

steam kettles in place of open ranges and installing energy efficient lighting for the existing facility. For the renovation, the energy audit promoted installation of energy efficient kitchen equipment, new cooling system strategies, an advanced ventilation control system, upgrading refrigeration systems, and investigating solar water heating.

Sandia's P2 group also funded simulations of three scenarios for a baseline building energy design, demonstrating how optimum energy efficiency can be achieved in the facility redesign through a systems engineering approach.



AP1 includes carbon dioxide: sulfur and nitrous oxides

AP2 includes carbon dioxide

Air exchange between all areas

In accordance with the systems approach, process maps were developed for Sandia National Laboratories' cafeteria food preparation activities, heating, ventilation, air conditioning, and lighting. Baseline waste generation and energy consumption data were collected and provided the basis for the development of process maps like this one, which were used to identify elements and/or areas where solid waste generation and energy usage appears high.

Contact Mary Ann Olascoaga, SNL P2/IT Group, 505-262-8704 or molasco@sandia.gov

P2 Council is established for all departments at Y-12 Plant

The Y-12 Plant has modified its Pollution Prevention (P2) Program organization to revolve around a P2 Council made up of individual P2 Advocates from each Y-12 Plant organization. Through 1998, the Council identified approximately 300 projects that would result in the reduction of over 509 million kilograms of waste at a cost savings of \$15.5 million dollars.

The Council's individual P2 Advocates are generally waste certifiers with training in waste characterization and management, plus a direct line of communication to their organizational managers. The Council meets formally once every quarter, but Advocates communicate via e-mail and meet on an as-needed basis, aided by the Y-12 P2 Program staff.

Advocates provide information about wastes generated for reporting purposes and serve as the P2 technology transfer points within their organizations, ensuring that new projects consider P2 in their design and construction and submitting to management suggestions for pollution prevention efforts that originate within their organizations.

In 1998, the Council participated in a series of team-building workshops in an effort to strengthen Advocates' communications skills and productivity and to identify barriers to P2 and develop strategic plans to overcome those barriers. Advocates also participated in various site pollution prevention opportunity assessments (PPOAs), plus an outreach PPOA of maintenance operations at the nearby Great Smoky Mountains National Park.

Contact Eva Irwin, Y-12 P2 Program, 423-241-2581 or exi@ornl.gov

Jefferson Lab's Free Electron Laser exceeds design goals

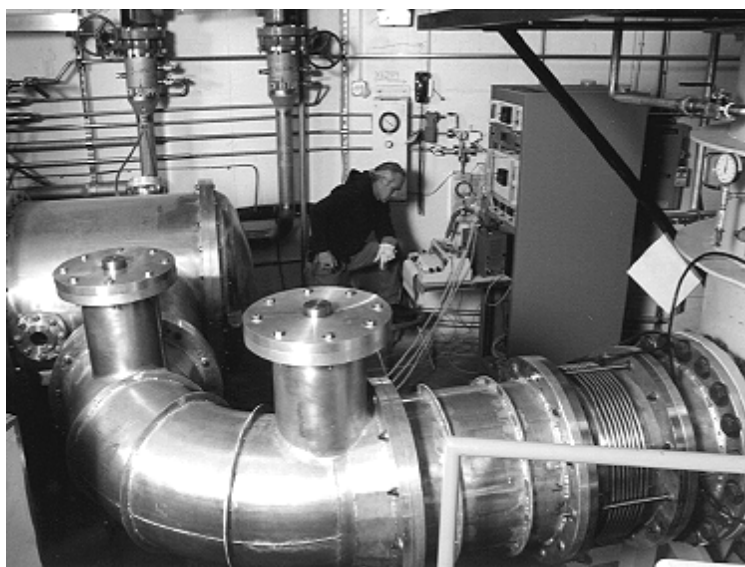
The U.S. Department of Energy's (DOE) Thomas Jefferson National Accelerator Facility (Jefferson Lab) in Newport News, Va., exceeded its design goal in July by producing 1,720 watts of infrared light from its Free Electron Laser (FEL), making it the most powerful of its kind in the world.

The goal had been 1,000 watts, which, by comparison, is a million times more powerful than the laser in a supermarket scanner. Previously, an 11-watt FEL at Vanderbilt University was the most powerful. Recirculating unused energy and feeding it back into the laser-producing process is one reason the FEL can efficiently produce this level of light. The Jefferson Lab's process recovers 75 percent of the energy used to make laser light.

The laser offers researchers a unique tool for science and

industrial processing with light. The FEL may have a wide range of applications in manufacturing, including processing of

plastics, more durable synthetic fibers, corrosion resistant metals and advanced materials and components for electronics and microtechnologies. Initial industrial experiments are applying the laser to roughening plastics, creating hardened and corrosion-resistant metal surfaces, and machining miniature structures in ceramics. Many of these processes have the potential of saving energy and being more environmentally acceptable than conventional manufacturing techniques.



Tim Siggins, Senior Technical Associate, monitors parameters from the electron source for the Jefferson Lab's Free Electron Laser in preparation for startup.

Contact Linda Ware, Jefferson Lab, 757-269-7689 or ware@jlab.org

'Carbon sequestration' may prove crucial to saving the climate

Researchers at the U.S. Department of Energy's (DOE) Lawrence Berkeley (LBL) and Lawrence Livermore National Laboratories (LLNL) will collaborate on a study to determine whether the oceans are an environmentally acceptable alternative for "carbon sequestration"—the capture and long-term storage of atmospheric carbon dioxide (CO₂).

The labs have been named co-hosts of one of two new DOE centers for global climate change research. "DOE has two Sequestration Centers. One focuses on ocean sequestration. That Center is jointly located at LBNL and LLNL. The second Center focuses on terrestrial sequestration. That one is located at Oak Ridge National Laboratory, Pacific Northwest National Laboratory and Argonne National Laboratory," explained Sally Benson, director of Berkeley's Earth Sciences Division.

"The Centers will help coordinate research across an enormous breadth of disciplines from both government and academia," said Martha Krebs, director of DOE's Office of Science. "Breakthroughs from these centers could lead to new, environmentally acceptable ways to help address this global problem."

Benson is co-chair of a national task force commissioned by DOE to develop a research roadmap for investigating carbon sequestration. The goal is to prevent CO₂ emissions from reaching the atmosphere by capturing a significant amount, as much as 4 billion tons by the year 2050, and securely storing it.

"The idea behind carbon sequestration is to capture and isolate the carbon at the source of emission or remove it from the atmosphere," Benson said.

The Center for Research on Ocean Carbon Sequestration is to receive a total of \$3 million over the next three years. The Berkeley leader will be Earth Science Division's Jim Bishop while Livermore's leader will be Ken Caldeira. Initial collaborators will include

Massachusetts Institute of Technology, Moss Landing Marine Labs, the Pacific International Center for High Technology Research, Rutgers University, and the Scripps Institute of Oceanography.

Two investigations will focus on the direct injection of CO₂ into the deep ocean and the fertilization of the ocean surface with nutrients that promote the growth of CO₂-absorbing marine organisms such as plankton.

Industrialized society is threatened by global warming created by the emission of an enormous amount of CO₂. Experts expect atmospheric CO₂ concentrations to double from pre-industrial levels by the middle of the next century, with grave environmental consequences.

Contact Sally Benson, LBNL, 510-486-5875 or SMBenson@lbl.gov

Argonne laser research benefits the rail industry

When steel rails are laser glazed, trains travel on them with significantly reduced friction, according to research at the U.S. Department of Energy's (DOE) Argonne National Laboratory. The laser glazing process can significantly reduce the high costs railroad companies pay due to energy losses from friction and friction-induced rail cracking. Argonne scientist Ron DiMelfi said laser glazing will be applicable to other areas involving friction and wear on metal equipment and parts. Railroad companies estimate reducing rail-wheel friction could save \$56 million per year in fuel and rail replacement costs.

Contact Donna Jones, ANL, 630-252-5501 or djpelkie@anl.gov

New laboratory studies alternative fuels

Part of an expansion at the Combustion Research Facility at the U.S. Department of Energy's (DOE) Sandia National Laboratories in Livermore, Calif. is dedicated to enhancing understanding of combustion, an age-old tool that supplies about 90 percent of the energy used in the U.S. today but remains poorly understood.

One section of the facility that opened in November is dedicated to examining how alternative fuels, including plant-based biofuels, operate in a working engine. It is hoped research conducted there will reduce dependence on petroleum imports and help improve the environment.

Scientists there will study how relatively clean-burning fuels work in a heavy-duty diesel engine. Heavy-duty diesel-cycle engines are typically 30-60 percent more efficient than comparable horsepower engines that use spark ignition.

"Right now, relatively little is known about why some fuels produce less pollution than others. Understanding how fuel properties affect emissions is an essential step toward production of cleaner, more efficient engines for the next century," said Combustion Research Facility researcher Chuck Mueller.

Contact Nancy Garcia, Sandia/CA, 925-294-2932 or Bob Gallagher, Sandia/CA, 925-294-3117

Millennial ideals lead the way at Pollution Prevention Conference 99

William McDonough, Dean of the School of Architecture and Edward E. Elson Endowed Professor at the University of Virginia (UVA) in Charlottesville, is partner in both William McDonough & Partners, an architectural firm, and McDonough Braungart Design Chemistry, a product research and design company. He founded the Institute for Sustainable Design at UVA, and is the first recipient of the Presidential Award for Sustainable Development and the winner of *Interiors* magazine's 1999 Designer of the Year Award, as well as being named *Time* magazine's February 1999 "Hero for the Planet." McDonough, along with German chemist Dr. Michael Braungart, has also developed a set of principles for sustainable design, development, and construction.

In February 1992, McDonough and Braungart worked with the Environmental Protection Encouragement Agency in Hamburg, Germany, to craft the set of guidelines listed below to reflect the theme of *EXPO 2000, The World's Fair — Humanity, Nature and Technology* — which is to be hosted by Germany's City of Hannover.

McDonough, a keynote speaker at DOE's recent Pollution Prevention Conference in Albuquerque, presented to conference attendees a special edition of the book that explains these principles and offers background material on the goals of *The World's Fair. The Hannover Principles* (©1992 William McDonough Architects), are reproduced with permission here. More information on McDonough's innovative designs and his philosophy for and beyond sustainable development will be presented in the 1st Quarter 2000 issue of *ESAVE*.

1. **Insist on rights of humanity and nature to co-exist** in a healthy, supportive, diverse and sustainable condition.
2. **Recognize interdependence.** The elements of human design interact with and depend upon the natural world, with broad and diverse implications at every scale. Expand design considerations to recognize even distant effects.
3. **Respect relationships between spirit and matter.** Consider all aspects of human settlement including community, dwelling, industry, and trade in terms of existing and evolving connections between spiritual and material consciousness.
4. **Accept responsibility for the consequences of design** decisions upon human well-being, the viability of natural systems and their right to coexist.
5. **Create safe objects of long-term value.** Do not burden future generations with requirements for maintenance or vigilant administration of potential danger due to the careless creation of products, processes or standards.
6. **Eliminate the concept of waste.** Evaluate and optimize the full life-cycle of products and processes, to approach the state of natural systems, in which there is no waste.
7. **Rely on natural energy flows.** Human designs should, like the living world, derive their creative forces from perpetual solar income. Incorporate this energy efficiently and safely for responsible use.
8. **Understand the limitations of design.** No human creation lasts forever and design does not solve all problems. Those who create and plan should practice humility in the face of nature. Treat nature as a model and mentor, not as an inconvenience to be evaded or controlled.
9. **Seek constant improvement by the sharing of knowledge.** Encourage direct and open communication between colleagues, patrons, manufacturers and users to link long term sustainable considerations with ethical responsibility, and re-establish the integral relationship between natural processes and human activity.

The *Hannover Principles* should be seen as a living document committed to the transformation and growth in the understanding of our interdependence with nature, so that they may adapt as our knowledge of the world evolves.

Bay Area to be site of first Defense Programs workshop in new century

ESAVE readers are invited to make plans to attend the U.S. Department of Energy (DOE) Defense Programs' 16th Biannual Pollution Prevention Technology Workshop, scheduled for Feb. 14-17, 2000. As in previous workshops, there will be a Monday evening reception with workshop sessions beginning Tuesday morning and continuing through Thursday noon. The workshop will be co-hosted by the Lawrence Berkeley National Laboratory.

Workshop sessions will be held at the Radisson Hotel Berkeley Marina in Berkeley, Calif. Topic area groups will visit Bay Area industries and organizations which are leaders in environmental stewardship and pollution prevention. Specific topics and featured speakers have yet to be determined, but that information, along with registration and other details, will be placed on the Defense Programs' Current Workshop homepage at www.dp.doe.gov/dp45/p2/ when plans are complete after the first of the new year.

Contact Julie Lyons, McPherson Environmental Resources, Inc., 423-543-5422 or mers@usit.net

U.S. Department of Energy Defense Programs' 16th Biannual Pollution Prevention Technology Workshop



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